CONTENTS

Editor's Introduction ix
Peter Rodgers

Challenges and Opportunities for Nanoscience and Technology xi
James R. Heath

NANOMATERIALS AND NANOSTRUCTURES

Progress towards monodisperse single-walled carbon nanotubes 3
Mark C. Hersam

The rise of graphene 11
A. K. Geim & K. S. Novoselov

Multiferroics: progress and prospects in thin films 20
R. Ramesh & Nicola A. Spaldin

Inorganic nanotubes and fullerene-like nanoparticles 29
R. Tenne

The role of interparticle and external forces in nanoparticle assembly 38
Younjin Min, Mustafa Akbulut, Kai Kristiansen, Yuval Golan & Jacob Israelachvili

Complex thermoelectric materials 50
G. Jeffrey Snyder & Eric S. Toberer

Solid-state nanopores 60
Cees Dekker

Engineering atomic and molecular nanostructures at surfaces 67
Johannes V. Barth, Giovanni Costantini & Klaus Kern

MOLECULAR MACHINES AND DEVICES

Making molecular machines work 79
Wesley R. Browne & Ben L. Feringa

Molecular logic and computing 90
A. Prasanna de Silva & Seiichi Uchiyama

Harnessing biological motors to engineer systems for nanoscale transport and assembly 102
Anita Goel & Viola Vogel

Designed DNA molecules: principles and applications of molecular nanotechnology 113
Anne Condon

DNA nanomachines 124
Jonathan Bath & Andrew J. Turberfield

NANOELECTRONICS

Nanoelectronics from the bottom up 137
Wei Lu & Charles M. Lieber

The emergence of spin electronics in data storage 147
Claude Chappert, Albert Fert & Frédéric Nguyen Van Dau

Nanoionics-based resistive switching memories 158
Rainer Waser & Masakazu Aono

Technology and metrology of new electronic materials and devices 166
Eric M. Vogel

Carbon-based electronics 174
Phaedon Avouris, Zhihong Chen & Vasili Perebeinos

Electron transport in molecular junctions 185
N. J. Tao

Molecular spintronics using single-molecule magnets 194
Lapo Bogani & Wolfgang Wernsdorfer

NANOPHOTONICS

Light in tiny holes 205
C. Genet & T. W. Ebbesen

Nano-optics from sensing to waveguiding 213
Surbhi Lal, Stephan Link & Naomi J. Halas

Semiconductor quantum light sources 221
Andrew J. Shields

Biomimetics of photonic nanostructures 230
Andrew R. Parker & Helen E. Townley

NANOBIOTECHNOLOGY AND NANOMEDICINE

Nanoparticle therapeutics: an emerging treatment modality for cancer 239
Mark E. Davis, Zhuo (Georgia) Chen & Dong M. Shin

Neuroscience nanotechnology: progress, opportunities and challenges 251
Gabriel A. Silva

The potential and challenges of nanopore sequencing 261
Daniel Branton et al.

Atomic force microscopy as a multifunctional molecular toolbox in nanobiotechnology 269
Daniel J. Müller & Yves F. Dufrêne

Immunological properties of engineered nanomaterials 278
Marina A. Dobrovolskaia & Scott E. McNeil

Injectable nanocarriers for biodetoxification 288
Jean-Christophe Leroux

SELECTED APPLICATIONS

Applications of dip-pen nanolithography 297
Khalid Salaita, Yuhuang Wang & Chad A. Mirkin

Biosensing with plasmonic nanosensors 308
Jeffrey N. Anker, W. Paige Hall, Olga Lyandres, Nilam C. Shah, Jing Zhao & Richard P. Van Duyne

Materials for electrochemical capacitors 320
Patrice Simon & Yury Gogotsi

Future lab-on-a-chip technologies for interrogating individual molecules 330
Harold Craighead

Science and technology for water purification in the coming decades 337
Mark A. Shannon, Paul W. Bohn, Menachem Elimelech, John G. Georgiadis, Benito J. Mariñas & Anne M. Mayes